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Short Communication

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Agronomic management systems for rehabilitation and sustained crop production in coastal agro ecosystem of Tamil Nadu, India

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ABSTRACT

Field experiments were conducted in the degraded coastal agro ecosystem with different land management methods and ameliorative amendments such as to boost the growth of identified MPT's in degraded soil. The field experiment were laid out in split plot design and consisted of 16 treatment combinations with four land management treatment in the main plots (M_1-pit method, M_2-trench method, M_3-mound method and M_4-Auger hole method) and four ameliorative treatment in sub plots (S_1-FYM @ 12.5 t ha^{-1} + Gypsum @ 200 kg ha^{-1}+ $ZnsO_4$ @ 25 kg ha^{-1} + Azospirillum @ 2kg ha^{-1}+ Phosphobacteria @ 2 kg ha^{-1}, S_2- Pressmud @ 15 t ha^{-1}+ Gypsum @ 200 kg ha^{-1}+ $ZnsO_4$ @ 25 kg ha^{-1}+ Azospirillum @ 2kg ha^{-1} + Phosphobacteria @ 2 kg ha^{-1}, S_3– Composted coir pith @ 10 t ha^{-1} + Gypsum @ 200 kg ha^{-1} + $ZnsO_4$ @ 25 kg ha^{-1} + Azospirillum @ 2 kg ha^{-1}+Phosphobacteria @ 2 kg ha^{-1} and S_4- no amendments). The treatment was replicated three times for the identified MPT's of *Pongamia pinnata* Based on the results of present study it can be clearly found that trench method of planting in combination with FYM @ 12.5 t ha^{-1}, Gypsum @ 200 kg ha^{-1}, $ZnsO_4$ @ 25 kg ha^{-1}, Azospirillum @ 2 kg ha^{-1} and phosphobacteria @ 2 kg ha^{-1} recorded the highest establishment percentage height, girth, PGR and taproot length of identified MPT's of *Pongamia pinnata* n the degraded coastal soil.

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INTRODUCTION

Soil resource is of vital importance for survival and welfare of the people in the world and for the sustainability of the ecosystem [1]. Soil degradation is happening as a results of many factors like pollution, improper agricultural activities and the plant and animal population will suffer disproportionately from its effect. Land degradation links with loss of organic carbon, and other properties (direct effect), reduction in crop productivity, biodiversity and climate change (Indirect effect) [2].

Coastal land occupies an area of about 8.4 m ha in India and Tamil Nadu has a coastline of 1000 km under 13 regions. Many of these sites are affected with salinity and experience standing water through much of rainy season due to an underlying restrictive layer, most often a canker pan, resulting in an anaerobic atmosphere for root and subsequently poor survival of vegetation [3]. In addition to the above, the degraded coastal lands experience frequent summer drought, which also contributes to reduced crop vegetation. Chemical reclamation of such degraded land is expensive and growing trees to reclaim them offers a cost efficiency and promising option (phytoremediation) as reported by Dagar *et al.* [4]. Now- a-days introduction of forestry in a degraded land have a significant impact for sustainable development *viz.*, conserve the ecosystem, prevents further land degradation, provide employment opportunity and allow the replacement of dung as fuel thus making it to be used as organic manure [5].

Identification of Multi Purpose Tree Species (MPT's) for the coastal agro forestry system could offer ecological and economic security to the farming community [6]. Research has shown that the effects of land management method and ameliorative amendments can be very site specific, especially on degraded sites. In this perspective it has becomes absolutely necessary to develop our native resources, in such way that they cause least destruction to soil and ecosystem.

Tamil Nadu coastal region is an ideal and common working unit of all agricultural development activities but the presence of considerable extent of degradable soil hampered the agricultural productivity. It seeks to promote

an appropriate environmentally land use practice that contribute to conservation and sustainable use of natural resource under changing climatic scenario. Keeping these in view these aspects, this study was designed to test the importance of land management methods and ameliorative amendments for the identified Multi-Purpose tree species (MPT's) for the rehabilitation degraded coastal agro ecosystem of Tamil Nadu.

MATERIALS AND METHODS

The study sites are located at Northern Cauvery delta coastal region of Tamil Nadu. It is geographically located from 11^0 22' to 13^0 28' N latitude and 79^0 45' to 80 20' E longitude with an average altitude of +5.57 M above Mean sea level. The coastal agro ecosystem of the region extends from semi arid to sub humid climate with a mean annual rainfall of 1350 mm of which 80 per cent is received during north – east moon soon (October - December). The mean annual maximum and minimum temperature are 33.5^0C and 23.5^0C respectively. The field experiment were laid out in split plot design and consisted of 16 treatment combinations with four land management treatment in the main plots (M_1-pit method, M_2-trench method, M_3-mound method and M_4-Auger hole method) and four ameliorative treatment in sub plots (S_1- FYM @ 12.5 t ha^{-1} + Gypsum @ 200 kg ha^{-1} + ZnsO4 @ 25 kg ha^{-1}+Azospirillum @ 2 kg ha^{-1} + Phosphobacteria @ 2 kg ha-^{1}, S_2 - Pressmud @ 15 t ha^{-1} + Gypsum @ 200 kg ha^{-1} + ZnsO4 @ 25 kg ha^{-1} + Azospirillum @ 2kg ha^{-1} + Phosphobacteria @ 2 kg ha^{-1}, S_3 – Composted coir pith @ 10 t ha^{-1}+ Gypsum @ 200 kg ha^{-1} + ZnsO4 @ 25 kg ha^{-1} + Azospirillum @ 2 kg ha^{-1} + Phosphobacteria @ 2 kg ha^{-1} and S_4- no amendments). Based on the studies, *Pongamia pinnata* was selected as more suitable MPT's for degraded sub zone. The various biometric observations were recorded during the experimentations were statistically analyzed.

RESULTS AND DISCUSSION

The results were presented in Tables 1 and 2. Among the different treatments, adoption of trench method with the apply of FYM @ 12.5 t ha^{-1}, Gypsum @ 200 kg ha^{-1}, $ZnS0_4$ @ 25 kg ha^{-1}, *Azospirillum* @ 2 kg ha^{-1} and Phosphobacteria @ 2 kg ha^{-1} significantly recorded the highest establishment percentage of 78.72, plant height of 243.50 cm (36 months) and girth of 16.05 cm (36 months), Least observations were recorded in M_4S_4 (auger hole method of planting without ameliorative amendments). The integrated approaches provided a better soil environment through draining of excess water, leaching out excess salts from root zone, slow and steady availability of plant nutrients which provided a better environment for increased establishment percentage, plant height and girth of *Pongamia pinnata*. Further addition of zinc is necessary for root cell memberances integrity and functions of the bio memberances of plants and alleviates possible Na and Cl injury by inhabiting Na and/or Cl uptake and translocation of plants. Similar results are reported by Dagar and Singh [7], Ramoliya and Pandey [8] and Pazanivelan *et al* [9].

Ameliorative Effect of MPT's on Land Rehabilitation

There was a reduction in soil bulk density,soil pH, soil EC and a corresponding increase in pore space, water holding capacity, organic carbon, available soil nitrogen, phosphorous and potassium were observed in *Pongamia pinnata*.The MPT's have an extensive characteristics root system for their proliferation and penetrating deeper layer is the major factor responsible for improved soil properties. The physical interaction occurred in the rhizosphere, especially as a consequence of root growth, penetration and their proliferation, rhizodeposition, microbial activity and root-soil interface created a heterogeneous soil matrix with physical properties which in turn helped in the improvement of soil physico-chemical properties. The improvements of soil quality is due to MPT's planting are in

Table 1: Effect of land management method and ameliorative amendments on the establishment percentage and performance of *Pongamia pinnata* in the degraded soil of Northern Cauvery delta zone

	Pongamia pinnata														
Treatment	Establishment percentage					Plant Height (cm)					Girth (cm)				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_4	M_4	Mean
S_1	65.22 (53.86)	78.72 (62.25)	73.21 (58.83)	69.46 (56.45)	71.65 (57.85)	205.22	243.50	225.58	187.26	215.39	13.80	16.05	14.86	12.51	14.31
S_2	52.26 (46.30)	70.28 (56.96)	61.18 (51.46)	58.26 (49.75)	60.50 (51.12)	188.81	221.61	204.21	168.62	195.81	11.72	13.87	12.70	10.30	12.15
S_3	56.26 (48.59)	74.63 (59.96)	66.22 (54.46)	63.28 (52.70)	65.10 (53.88)	178.42	213.38	195.42	159.62	186.71	10.68	12.85	11.63	09.29	11.11
S_4	46.68 (43.09)	68.36 (55.77)	58.22 (59.73)	48.32 (44.04)	55.40 (50.66)	160.51	186.31	184.78	145.36	169.14	08.29	10.64	09.59	07.01	08.98
Mean	55.11 (47.96)	73.00 (58.69)	64.71 (56.12)	59.83 (50.74)		183.24	216.20	202.65	165.22		11.12	13.35	12.19	09.78	
	S.Ed		CD (P=0.05)			S.Ed		CD (P=0.05)			S.Ed		CD (P=0.05)		
M	1.10		2.23			5.15		10.50			0.35		0.73		
S	1.19		2.52			4.00		08.06			0.40		0.81		
M x S	1.52		3.20			6.95		14.20			0.49		1.03		

(Figure in parenthesis indicate arc-sine transformed value)

Table 2: Ameliorative effect of *Pongamia pinnata* on the rehabilitation of degraded soil

Soil Physico-chemical characters	Initial	36 month after planting	% changes (+/-)
Bulk density (g cc^{-1})	1.61	1.57	-2.48
Pore space (%)	36.5	38.8	+6.30
Water holding capacity (WHC) (%)	49.6	49.8	+0.40
Soil pH (%)	8.32	8.17	-1.80
Soil EC_e (dSm^{-1})	7.58	7.15	-5.67
Organic carbon (%)	0.23	0.26	+13.04
Available Nitrogen (kg ha^{-1})	137.35	147.05	+7.06
Available Phosphorous (kg ha^{-1})	06.75	07.27	+7.70
Available potassium (kg ha^{-1})	153.76	160.34	+4.28

line with the earlier report of Czarnes *et al.* [10], Horn and Smucker [11], Izquierdoa *et al*. [12] and Whalley *et al*. [13].

CONCLUSION

The results present investigation indicated that planting *Pongamia pinnata* under trench method of planting in combination with the application of FYM @ 12.5 t ha^{-1}, Gypsum @ 200 kg ha^{-1}, $ZnsO_4$ @ 25 kg ha^{-1}, Azospirillum @ 2 kg ha^{-1} and phosphobacteria @ 2 kg ha^{1} is the most appropriate agro techniques for rehabilitation of degraded coastal agro ecosystem and sustaine the crop vegetation.

REFERENCES

1. Doran JW. Soil health and global sustainability: translating science into practice. Agriculture, ecosystems & environment. 2002;88(2):119-27.
2. Gisladottir G, Stocking M. Land degradation control and its global environmental benefits. Land Degradation & Development. 2005;16(2):99-112.
3. Rekha PN, Ravichandran P, Gangadharan R, Bhatt JH, Panigrahi A, Pillai SM, Jayanthi M. Assessment of hydrogeochemical characteristics of groundwater in shrimp farming areas in coastal Tamil Nadu, India. Aquaculture international. 2013;21(5):1137- 53.
4. Dagar JC, Gurbachan S. Evaluation of fruit tree species for sodicity tolerance. Indian Journal of Forestry. 2000;23(4):390-6.
5. Miah MD, Shin MY, Koike M. Forests to climate change mitigation: clean development mechanism in Bangladesh. Springer Science & Business Media; 2010 Oct 1.
6. Lamers JP, Khamzina A, Worbes M. The analyses of physiological and morphological attributes of 10 tree species for early determination of their suitability to afforest degraded landscapes in the Aral Sea Basin of Uzbekistan. Forest Ecology and Management. 2006;221(1- 3):249-59.
7. Dagar JC, Singh NT, Singh G. Agroforestry options for degraded and problematic soils of India. Agroforestry System for Sustainable Land Use. Oxford and IBH Publishing, New Delhi. 1994:97-120.
8. Ramoliya PJ, Pandey AN. Effect of salinization of soil on emergence, growth and survival of seedlings of *Acacia nilotica*. Botánica complutensis. 2002;26(2002):105-19.
9. Pazhanivelan S, Amanullah MM, Vaiyapuri K, Alagesan KS, Rahale CS. Influence of planting techniques and amendments on the performance of neem (*Azadirachta indica*) and changes in soil properties in rainfed alkali soil. Research Journal of Agriculture and Biological Sciences, Jordan. 2006;2(6):443-6.
10. Czarnes S, Hallett PD, Bengough AG, Young IM. Root-and microbial- derived mucilages affect soil structure and water transport. European Journal of Soil Science. 2000;51(3):435-43.
11. Horn R, Smucker A. Structure formation and its consequences for gas and water transport in unsaturated arable and forest soils. Soil and Tillage Research. 2005;82(1):5-14.
12. Izquierdo I, Caravaca F, Alguacil MM, Hernández G, Roldán A. Use of microbiological indicators for evaluating success in soil restoration after revegetation of a mining area under subtropical conditions. Applied Soil Ecology. 2005;30(1):3-10.
13. Whalley WR, Riseley B, Leeds-Harrison PB, Bird NR, Leech PK, Adderley WP. Structural differences between bulk and rhizosphere soil. European Journal of Soil Science. 2005;56(3):353-60.